Space Weather Technical Forecast

Issued on Thursday, 26 May 2022 at 13:26 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of R1-R2 Radio Blackouts declining. CME arrival likely early day 3 (28th) with G1/G2 Minor to Moderate Storm intervals likely.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate, with an M1.3 at 25/1824UTC emanating from the region of ex-AR3016. AR3014 (Dkc/βγδ) and AR3017 (Dso/β) in the northwestern quadrant are both rotating towards the western limb, with neither region demonstrating significant activity. AR3023 (Hhx/α) on the southeastern limb has now been assessed as a relatively simple region, but will need monitoring for any further development. The remaining regions are either simple or declining and present only a small risk of significant flares. The M1.3 flare was followed by a moderately fast CME, which has been analysed as likely glancing Earth early morning on day 3 28th. No further Earth-directed CMEs have been observed on available imagery.

Solar Wind / Geomagnetic Activity: The solar wind observed by DSCOVR at L1, has been at ambient levels, below 400km/s with below average density. Total magnetic field strength was mainly weak, below 6nT, with the north-south component also weakly varying. Phi angle was positive (away from the Sun) for much of the period, but rotated to negative orientation from 25/1900UTC. Total geomagnetic activity was Quiet to Unsettled throughout.

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) has been at background levels through the last 24 hours. The high energy electron flux (greater than 2 MeV) has been mainly been at background to moderate levels, with a peak value of 605pfu at 25/1750UTC. Corresponding electron fluence remained well below the Active threshold (1e8 integrated pfu) with a falling trend to reach 1.9e7 integrated pfu at 26/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be mainly Low, but with a risk of further Moderate activity and a very slight risk of High activity. The main source of this heightened risk are two active regions in the northwest quadrant, with the risk decreasing as this rotates away around the west limb.

Solar Wind / Geomagnetic Activity: Currently ambient solar winds are likely to become enhanced later day 1 due to the arrival of the fast wind of CH84, with some potential influence of CH85. CME is then expected to arrive early day 3 at 28/0200 +/- 9 hours. This is likely to be a glancing impact, with solar winds easing back towards background day 4 (29th). Quiet geomagnetic activity at first day 1 (26th) is likely to become Unsettled to Active into day 2 (27th) with a slight chance of G1 Minor Storms. The impact of the CME gives a likelihood of G1/Minor Storms with a chance of G2 Moderate storms, most likely early day 3 (28th). Geomagnetic activity then easing day 4 (29th).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is expected to be at background levels during this period, with a slight chance of reaching S1/Minor Storm levels if any notable flares occur from the sunspot regions on the northwest limb. High energy electron flux (greater than 2MeV) is expected to remain below the high (1e3 pfu) threshold) with the electron fluence remaining below the Active (1e8 integrated pfu) threshold.

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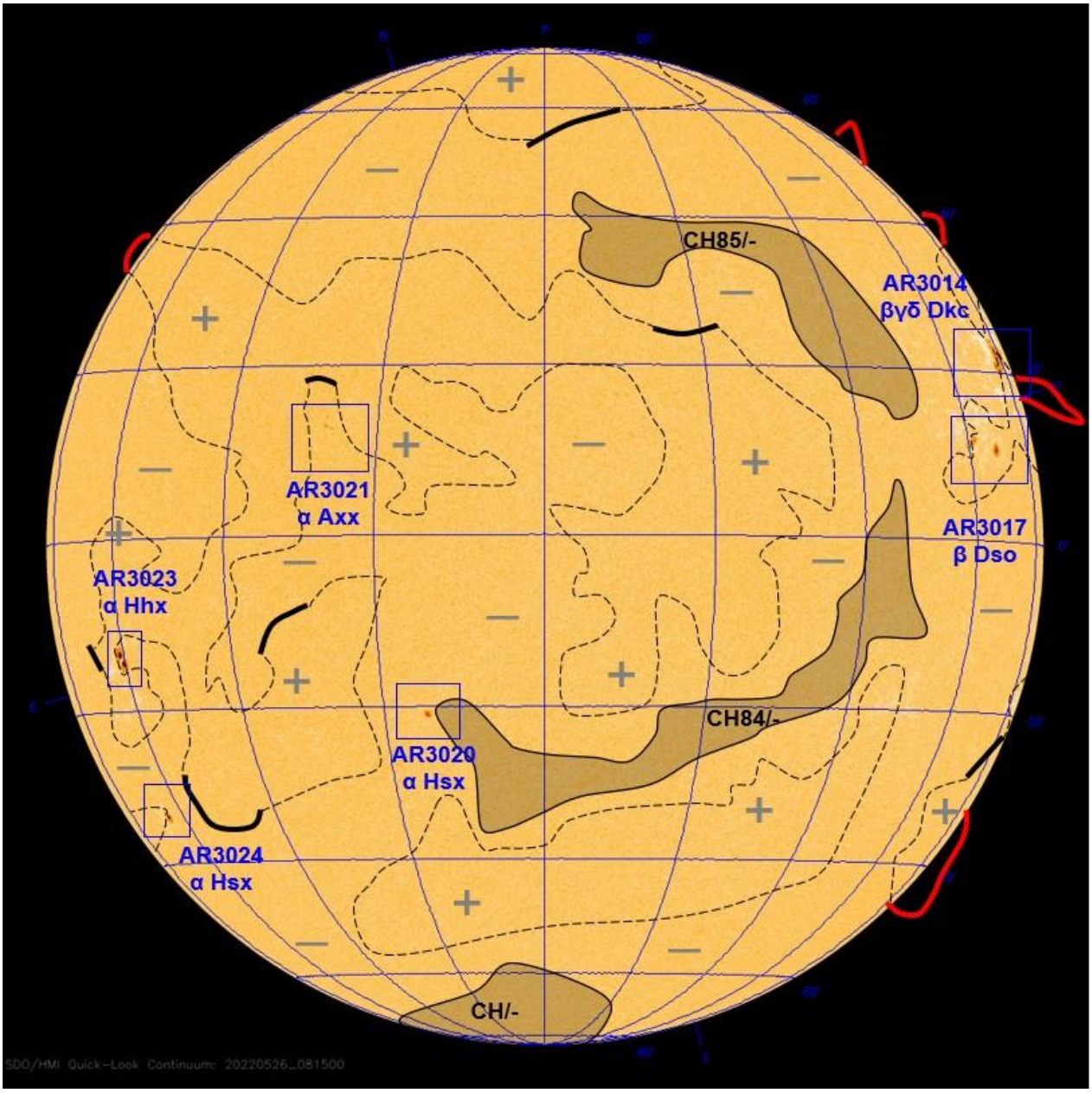
Although fluence potentially rising day 4 with high flux possible.

Figure 1. Solar Analysis Valid 26/0800.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

The CME from M1.3 flare of ex-3016 has been analysed as giving a glancing impact to Earth at 28/0200 UTC +/- 9 hours. No further Earth-directed CMEs are expected.

Solar winds are currently at background, but expected to become enhanced later day 1 and into day 2 (26th and 27th) by the arrival of the fast wind of coronal hole 84, with some influence possible from 85. This is a longitudinal extensive feature, with elevated solar winds potentially persisting for much of the period. These are likely to peak around 550-600 km/s.

Quiet geomagnetic activity at first day 1 (26th) is likely to become Unsettled to Active into day 2 (27th) with the coronal hole fast wind arrival, with a slight chance of G1 Minor Storms. The impact of the CME gives a likelihood of G1/Minor Storms with a chance of G2 Moderate storms, most likely early day 3 (28th). Geomagnetic activity then easing day 4 (29th).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	20	40	60	10
Strong	G3	No	1	5	10	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
25/1824	Partial	Ex-3016	40W 20S	1010 km/s	28/0200 +/- 9hours	Glancing impact possible.

Figure 1: SDO aia-94 showing the flaring of ex-3016

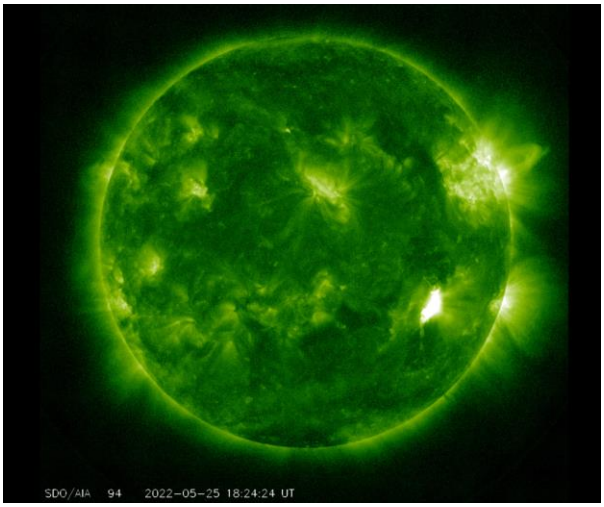

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Figure 3: ENLIL showing glancing arrival of CME

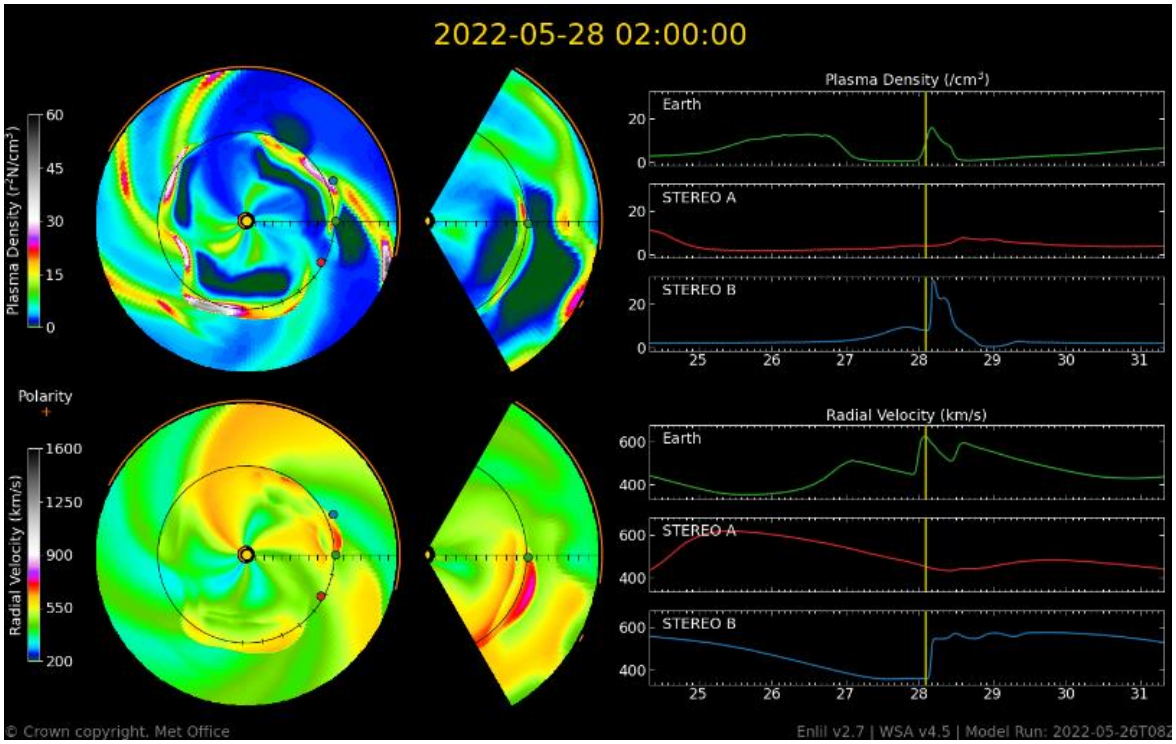
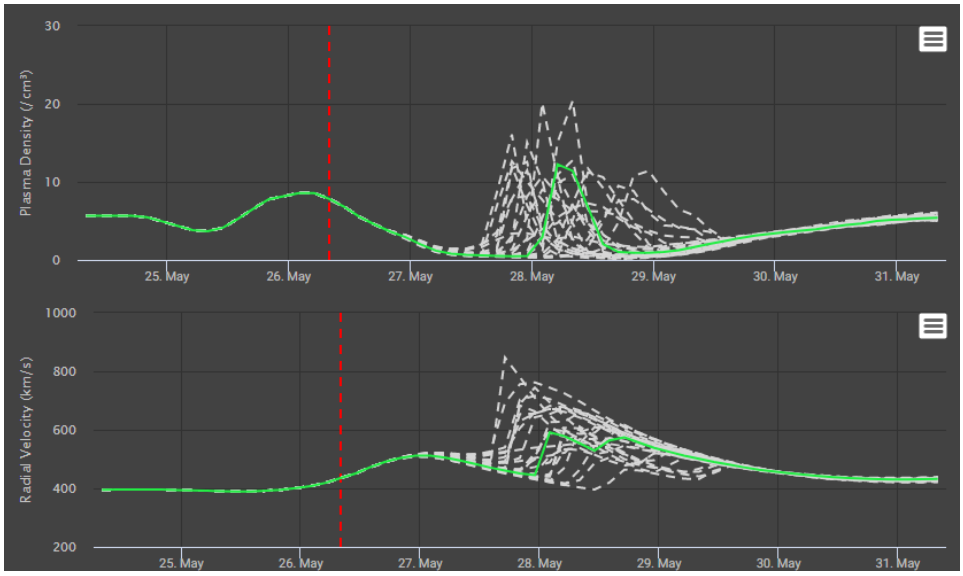


Figure 4: ENLIL Ensemble



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Radio Blackouts - X-Ray Flares:

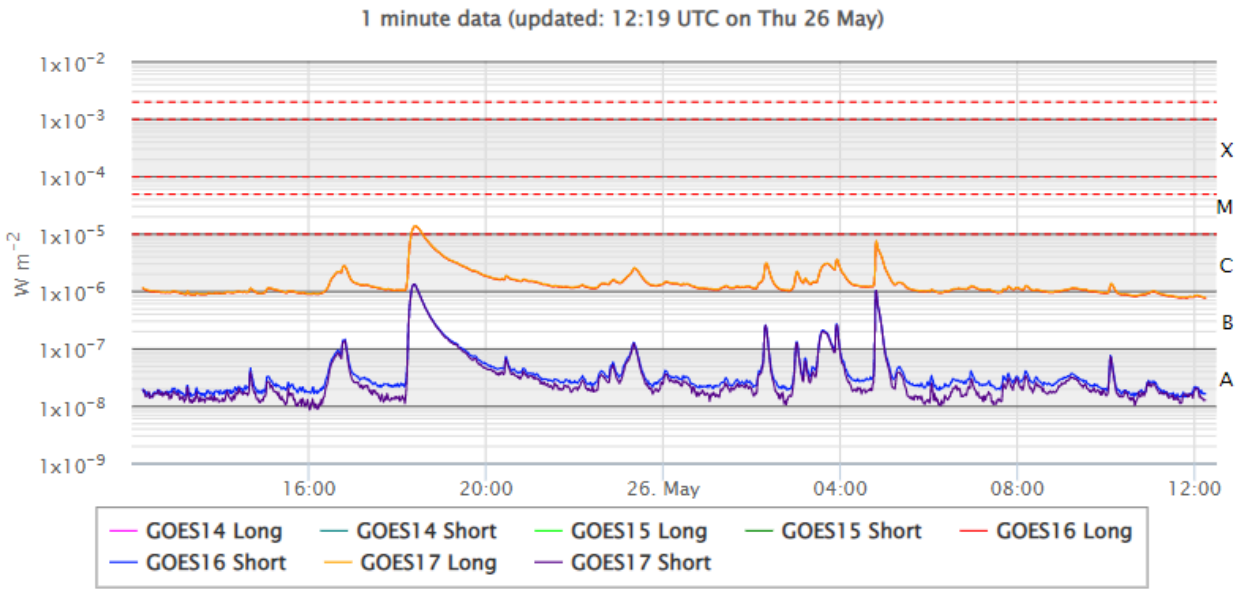
Solar activity is Moderate, with one M1.3 flare observed from the region of ex-AR3016 at 25/1824UTC. There are currently six sunspot regions on the Earth-facing disc. The most notable is the large region AR3014, Dkc/beta-gamma-delta, which is now approaching the west limb. This regions is increasingly hard to assess, however has seen very little growth or decay in the last few days, and hence its classification is maintained as it approaches the limb.

AR3017 Dso/Beta, also had a recent delta spot development to the north of its trailer, but has subsequently seen this decline with the umbra of the trailer becoming less visible. AR3023 Hhx/alpha was also originally considered a bipolar region with a delta, but this has been reassessed as a unipolar spot as it has moved into a clearer view. The other three regions are smaller and simpler.

Current activity is likely to become Low with a chance of Moderate, due to any further M-class flaring, with only a slight chance of isolated X-class flares, primarily from AR3014 as it rotates over the west limb.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	30	30	20	10
Very Active	R3 to R5 X Class	No	10	5	2	1

Figure 5: GOES-16/17 X-ray flux



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Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is at background levels and is most likely to remain so through the period. There is a slight, but decreasing risk of increased proton flux, and solar radiation storms, as AR3014 and AR3017 rotate off the Earth-facing disc and over the east limb.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	5	2	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

The High energy electron flux (as measured by GOES-16) is currently at background to Moderate, with a declining trend. This is likely to drop out with any fast wind arrival later day 1 (26th), and with any subsequent CME arrival, most likely early day 3 (27th). As any CME influence recedes, High flux is possible by the end of day 4 (28th).
The associated 24 hour fluence is expected to remain at background with no notable extended periods of high flux expected through the period, although likely increasing day 4 (29th). This is supported by REFM, which shows a declining trend for days 1-3 (26th-28th).

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	5	20
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

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Figure 6: GOES-16 Electron flux (top) and associated fluence with REFM (bottom)

NOTE: Our REFM model has been upgraded and has changed in appearance. The two main changes are the option to include a recurrence graph, which superimposes observations from the last solar rotation onto the current solar rotation (each plot is the observation from T-minus 28 days). Recurrence is used as a guide to what can be expected in the coming days assuming no difference in solar features, and has low accuracy in certain situations but good accuracy in others (such as recurring coronal holes). The other change is the cadence of REFM forecast fluence data has been reduced past day 1 to only one value per day. The cadence remains 3-hourly for the first 24 hours.

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